

## MIXING AND FLOW CONDITIONING IN FRONT OF A CATALYST BED FOR A SCR PROCESS

There are many methods currently available to improve the conversion of  $\text{NO}_x$  into harmless  $\text{N}_2$ . One of the more popular is the use of Selective Catalytic Reduction (SCR). SCR utilizes a solid bed catalyst, which converts  $\text{NH}_3$  and  $\text{NO}_x$  to  $\text{N}_2$  and  $\text{H}_2\text{O}$ . In order to achieve the optimum performance of this system, the flue gas flow must have the proper concentration and distribution of  $\text{NH}_3$  and  $\text{NO}_x$ , uniform temperature distribution, uniform velocity and controlled flow direction. Only when these conditions are under control can the selectivity of the  $\text{NO}_x$  reduction, the slip rate of ammonia, and the life of the catalyst be guaranteed.

A common  $\text{NH}_3$  injection technique is to employ a nozzle grid. Nozzle grids inject the ammonia at numerous points and thus distribute it across the duct. While grids are capable of injecting  $\text{NH}_3$  across the grid, they can be complicated to operate.  $\text{NO}_x$  profiles in the flue gas can change due to the boiler type, duct arrangement and changing process conditions. As a result, grids will need to be adjusted or “trimmed” in the field for differing process or firing conditions.

An alternative to nozzle grids is the use of static in-line mixers. The advantage of a static mixer is that it distributes the ammonia across the duct section while simultaneously mixing the  $\text{NO}_x$  profile coming from the boilers. This removes the requirement for trimming and reduces the expense of complicated injection grids. Static mixers also provide uniform velocity and temperature profiles to the catalyst bed and are capable of handling varied  $\text{NO}_x$  profiles with virtually no maintenance.

One installation Sulzer Chemtech has supplied recently illustrates how static mixers can be used to solve a difficult  $\text{NO}_x/\text{NH}_3$  SCR problem. As is typical for these installations, space prior to the catalyst was tight. To further complicate the problem, the duct geometry upstream of the catalyst is extremely complex. The specifications for  $\text{NH}_3$  homogeneity and velocity distribution were also strict. By using computational Fluid Dynamic (CFD) modeling, a mixer system, injection system and flow conditioners could be designed and a test model was built. By combining the CFD and scale test model, detail modifications could be made to determine guarantee values for homogeneity, velocity distribution and pressure drop. Based on actual model tests, a full-scale design was completed and installed.

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**Equipment :** Over head projector